

AMENDMENTS TO THE DRAWINGS

Applicants are enclosing herewith one (1) sheet of replacement drawings containing modifications to Figs. 20A-20D. The submitted drawing is intended to replace the Figs. 20A-20D originally filed on October 15, 2003 and are believed to comply with the suggestions made by the Examiner during the interview conducted on September 11, 2006.

REMARKS

Claims 1 and 4-22 are all the claims pending in the application. Claims 12-20 are withdrawn from consideration as being drawn to a non-elected invention. Claims 1, 4-11, 21 and 22 presently stand rejected. Applicant has amended claims 1 and 21, and has added new dependent claims 23 and 24 to further define the clearance that exists between the outer surface of the shaft and the inner surface of the cylinder.

As a preliminary matter, Applicants wish to thank Examiner Garcia for the kindness extended during the personal interview conducted on September 11, 2006, at which the undersigned as well as Messrs. Inuzuka and Ieda were present on behalf of Applicants.

Drawings

Applicants are submitting a new sheet of drawings that adds a reference number to identify the clearance that appears between the cylinder and shaft, as discussed in the interview.

Specification

The Examiner has indicated that the specification is objected to on the Office Action Summary page. However, the Examiner did not indicate why the specification is objected to. Applicant respectfully requests clarification and indicates willingness to comply with reasonable requests that would improve the style and content of the disclosure.

As suggested by the Examiner at the interview, the specification and figures are amended to indicate with reference numerals and describe the presence of a "clearance" between the outer periphery of the shaft and the inner periphery of the cylinder, after the calking is created. As noted subsequently, this clearance permits the cylinder to be loosely fit over the surface of the shaft without force, thereby overcoming the problems identified in paragraph [0006] of the original specification.

Claim Objections

Claim 22 is objected to because the first occurrence of “the” in line 2 should be --an--. However, Applicants respectfully submit that claim 22 depends from claim 10 and, thus, this claim has proper antecedent basis.

Rejection Under 35 USC §112

Claims 9, 21 and 22 are rejected under 35 U.S.C. § 112, second paragraph. This rejection is traversed for at least the following reasons.

Regarding claims 9 and 21, the Examiner is unclear as to how the cylindrical member is apart from the shaft member except at the caulked portion. In order to clarify the limitations, Applicants have amended the claims to recite that a “clearance” is formed. This language is found in the originally filed specification (see paragraph [0067] of the published application) and is illustrated in Figs 20A-20D. As noted above, Applicants have identified the clearance with a reference number and have described it in the specification.

As described in the original specification at paragraph [0074] and [0075], the maximum outer diameter portion 2c of the input shaft (shaft member) 2 is smaller than the inner diameter of the inner-periphery-side cylinder 60 of the torque detection-side surrounding member 6. Thus, the surrounding (cylindrical) member 6 is loosely fitted to the outer periphery of the maximum outer diameter portion 2c (shaft member). The cylindrical member 6 is then caulked to the shaft member 2. Specifically, the cylindrical member 6 is fixed to the shaft member 2 by applying a punching force using tools, as illustrated in Fig. 15 to deform the surface material of the cylindrical member without breaking the surface. The caulked structure is necessarily formed after the cylinder is loosely fit over the outer surface of the shaft. The caulking is made at the intersection of the axial and circumferential grooves of the shaft member. However, the clearance still exists between the remaining portions of the cylindrical member and the shaft member. In view of the foregoing, claims 9 and 21 are definite.

Regarding claim 22, it is duly noted that claim 22 correctly depends from claim 10.

Claim Rejections – 35 USC 102

Claim 21 is rejected under 35 U.S.C. § 102(b) as being anticipated by Chikaraishi (6,301,957). This rejection is traversed for at least the following reasons.

Chikaraishi is discussed in the background portion of the originally filed specification. As discussed therein, Chikaraishi is directed to a structure of coupling a shaft member and a cylindrical member. However, the structure does not have a “clearance,” as now set forth in the claim, for at least two reasons.

First, in Chikaraishi, semispherical protrusions are formed beforehand on the inner peripheral surface of the cylindrical member so as to correspond to the pre-formed axial grooves of the shaft, and the height of these protrusions are substantially equal to the depth of the axial grooves, as explained at col. 6, lines 25-27. The protrusions are positioned and pushed to engage with the axial grooves. Then, the cylindrical member is further pushed until the end of the cylindrical member is over the circumferential groove. Clearly, where the protrusions fit into the grooves, the inner surface of the cylinder must engage the outer surface of the shaft, as there is nothing to keep the two apart.

Second, the patent teaches at col. 5, lines 55-59 that the “cylindrical member is fixed on the outer circumferential surface of the ..output shaft 3.” That is, the end portion of the cylindrical member is curved inward so as to engage with the circumferential groove 12. Unlike the present invention, there is concern that the cylindrical member undergoes deformation due to the strong pushing required to engage protrusions with the cylindrical member with the axial, and then the bent portion with the circumferential grooves.

Claim 21 now clearly recites that a **clearance** is formed between the shaft member and the **entire inner surface** of the cylindrical member **except** at the caulked portion. Chikaraishi does not disclose, teach or suggest this structure, as described above. No text in the specification and no illustration in the Figures suggest such feature. Indeed, all indications are to the contrary, since Chikaraishi specifically discloses “pushing” the cylinder onto the shaft, at col. 6, lines 32-34. By contrast, the present invention uses a clearance that permits the cylinder to be “loosely

fit" over the shaft so that a clearance exists between the shaft member and the cylindrical member along the entire overlapping surfaces, except for the location of the circumferential groove and bent portion. In other words, the shaft and cylinder have a clearance fit.

The Examiner has argued that a clearance is the same as a tolerance and, even if Chikaraishi has no specified clearance, the cylinder and shaft are made according to a "tolerance" and thus have a clearance. However, as argued by the Applicants' representative during the meeting, the two terms are very different and have different meanings in engineering. Wikipedia defines a "tolerance" as "the permissible limit of variation in a dimension or value of a parameter of a manufactured object. Dimensions and parameters may vary within certain limits without significantly affecting functioning of equipment; tolerances are specified to allow leeway for imperfections in manufacturing parts and components without compromising performance." Wikipedia makes clear that "tolerance" differs from a "clearance" or "clearance fit" as follows:

Tolerance is related to, but different from fit in mechanical engineering, which is a *designed-in* clearance or interference between two parts. For example, if a shaft with a nominal diameter of 10 millimeters is to have a sliding fit within a hole, the shaft might be specified with a tolerance range from 9.964 to 10 millimeters and the hole might be specified with a tolerance range from 10.04 to 10.076 millimeters. This would provide a clearance fit of somewhere between 0.04 millimeters (largest shaft paired with the smallest hole) and 0.112 millimeters (smallest shaft paired with the largest hole). In this case the size of the tolerance range for both the shaft and hole is chosen to be the same (0.036 millimeters), but this need not be the case in general

In view of the foregoing, claim 21 is not anticipated by Chikaraishi. Moreover, the claim would not be obvious in view of the absence of any clearance or clearance fit in Chikaraishi. First, Applicants teaching of an intentional clearance for a loose fit is contrary to and away from

the basic concept in Chikaraishi, which requires the surfaces of the shaft and cylinder to be in contact. Indeed, during assembly, the protrusions 13 and axial grooves 11 are in contact during assembly, as explained at col. 6, line 28. Further, the mating of the protrusions 13 with axial grooves 11 and the crimping of the end of the cylinder into circumferential groove 12 is not sufficient alone to secure the shaft and cylinder together for the intended purposes of the structure in Chikaraishi.

Claim Rejections – 35 USC 103

Claims 1, 4-7, 9 and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith et al. (3,688,521) in view of Chikaraishi (6,301,975) and Jackman (2,913,290). This rejection is traversed for at least the following reasons.

Claim 1

Claim 1, the only independent claim subject to the present rejection, is directed to a structure comprising a shaft member, a cylindrical member and a caulked portion that joins the shaft and cylinder by having a deformed inner surface in press contact with the opposed faces of axial and circumferential grooves. The claim further provides that the axial groove is greater in depth than the circumferential groove. The claim now has been amended to additionally provide that the surface of the caulked portion is continuous, that is, does not split, break or sever, as discussed at the interview.

Smith et al

Smith is directed to an outer member of a constant velocity universal joint. Such universal joints have an inner member and an outer member surrounding the inner member, with a ball received between the two members. In the rejection, the Examiner considers the shaft member to be 26 (known as the outer member in Smith), and the cylindrical member to be 25 (known as a tubular shaft in Smith). The so-called shaft member 26 has axial grooves 18 and a circumferential groove 21, which intersect. (See Fig. 4). Inwardly deformed portions 27, 28 appear to engage with the grooves 18, 21.

Smith fails to disclose:

- The cylindrical member being formed out of a second material greater in linear expansion coefficient than the first material;
- The axial groove is greater in depth than the circumferential groove; and
- The cylindrical member is caulked to the grooves so that the material is continuous, i.e., without tearing or cutting.

Further, there is no motivation for modifying the groove depths in Smith based on Jackman because the circumferential groove in Jackman is merely a short groove that holds the tabbed portions 24, 26. Because the sleeve 18 is a split bearing sleeve, which has its ends inserted into the axial groove 12, the short circumferential groove accommodates the tabs to keep the sleeve from sliding axially. There is no discussion in the description of Jackman to explain why one groove is deeper than another. In Smith, the circumferential grooves wrap completely around the circumference, and the cylindrical member 25 is not a split bearing sleeve and thus does not provide tab formations. If one of ordinary skill in the art were merely provided the cited references, one would not have had any motivation to modify Smith to make the axial groove 18 to be deeper than the circumferential groove 21. There is simply no motivation for this modification.

The rejections states that the modification is “to connect the cylindrical member to the shaft member of Smith et al.”; however, the cylindrical member is already connected to the shaft member in Smith, and there is no teaching or suggestion that changing the depth of the cylindrical groove would alter this connection.

Finally, another reason deals with the newly added limitation that the surface of the caulked portion is “continuous and deformed.” Clearly, in Jackman (Figs. 2 and 3, the walls of the sleeve are cut and tabs 20, 22 and 24, 26 are formed. Thus, the walls at the caulked portion are not continuous and unbroken. Instead, they are cut or torn.

Thus, claim 1 is not obvious. Moreover, the claims dependent thereon also are not obvious.

Claim 8 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith et al. (3,688,521) in view of Chikaraishi (6,301,975) and Jackman (2,913,290) and further in view of Fujioka et al. (4,716,756). This rejection is traversed for at least the following reasons.

The claim would be patentable for reasons given with respect to parent claim 1. The additional teachings in Fujioka et al do not remedy the deficiencies in the combination of Smith et al, Chikaraishi and Jackman.

Claim 10 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith et al. (3,688,521) in view of Chikaraishi (6,301,975) and Jackman (2,913,290), and further in view of Edgemon, Jr. (3,642,311). This rejection is traversed for at least the following reasons.

The claim would be patentable for reasons given with respect to parent claim 1. The additional teachings in Fujioka et al do not remedy the deficiencies in the combination of Smith et al, Chikaraishi and Jackman.

Claim 22 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Chikaraishi (6,301,957) and further in view of Smith et al. (3,688,521). This rejection is traversed for at least the following reasons.

The claim would be patentable for reasons given with respect to parent claim 21. The additional teachings in Smith do not remedy the deficiencies in Chikaraishi.

In sum, the remaining rejections are directed to the dependent claims. These claims should be patentable for at least the same reasons as claims 1 and 21, due to their dependency therefrom.

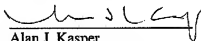
AMENDMENT UNDER 37 C.F.R. § 1.111
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Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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